Transportation Quality Indices for Economic Analysis of Non-Metropolitan Cities

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TRANSPORTATION QUALITY INDICES FOR ECONOMIC ANALYSIS OF NON-METROPOLITAN CITIES

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ABSTRACT

Although transportation plays a role in economic development, it often is assumed to be an inert factor because of data voids or under assumptions. This research offers estimates of the relative quality of freight and business transport service resources available to non-metropolitan cities across the United States. The U.S. economic geography is determined largely by its metropolitan population centers. Non-metropolitan cities offer an important nexus for seamless integration of our vast geography in terms of their location across rural areas and the role they play in integrating regional rural economies into the national and global market and for the potential they offer in generating agglomeration economies for a region. Indicators suggest that cities located in the Midwest have relatively higher freight transport service quality compared to non-metropolitan cities in other areas. Non-metropolitan cities in a cluster of northeastern states are at disadvantage, relative to non-metropolitan cities located in most states, considering the quality of freight service. Business travel service quality is highest in the eastern states, but range of service qualities is more randomly distributed across other regions compared to the freight transport quality distribution. The cluster of lower-quality freight transport service is a cause for concern as previous research suggests these lagging regions will likely become increasingly disadvantaged over time. Transportation quality indicators developed in this research offer a new opportunity to consider transportation and the associated data needs in analysis of economic development policies and strategies.

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INTRODUCTION

Access to markets is an important consideration in the ability of a region to function successfully in an integrated global trade network. Although causality in the transportation/economic development relationship is so mewhat hazy, it is still critical to consider transportation in policy and investment initiatives for economic development of non-metropolitan regions. Transportation affects the competitive position in sourcing from and supplying to other regions. This relative position that may be defined as a competitive advantage or disadvantage in growing a regional economy. Douglass North states that "improved positioning of existing exports relative to competing areas is an important aspect of regional growth" (North, 1955). Over the longer run, it is one of many factors that should be considered in the development of a regional economy (Tiebout, 1956). Understanding the position of a region's resources, relative to other regions competing for the same markets, may provide valuable guidance for decision makers both in making shorter-term decisions and in forming longer-term strategies.

A geographic boundary must be defined in discussing market linkages. Cities provide one such boundary. The cities of interest in this project are those located in rural or non-metropolitan areas. These cities may offer non-metropolitan regions the opportunity to achieve some agglomeration and concentration efficiencies enjoyed by larger metropolitan population centers. These efficiencies may, in turn, allow regions to grow their economies with more competitively positioned products and services.

This research is focused on the quality of transportation services available to city centers in non-metropolitan regions. These cities often play a pivotal role in economies of the surrounding region. Unlike larger metropolitan centers, commerce and trade generated by non-metropolitan regions may not be sufficient to create a competitive environment for freight or business travel. As the non-metropolitan cities and their surrounding regions make decisions regarding resource distribution, it is important to consider the transportation environment. A greater understanding of the competitive position of their transportation resources may allow them to more effectively enhance the regional economic development climate. As cities attempt to diversify economies, one means is attracting logistics and transport companies that serve all types of industries (Traffic World, 2003).

One of the challenges faced in integrating transport into discussions of economic development, particularly in small- to medium-sized cities, is a lack of data. The objective of this research is to create indices that offer insight into the quality of transportation available for businesses located in non-metropolitan areas. Two transportation indices will be developed – a freight transport index and a business traveler mobility index. These indices will provide a measure of transportation quality which reflects the relative quality of transport services. The indices can be incorporated into future endeavors directed at developing and growing non-metropolitan economies.

The research is composed of four sections. The first section offers a review of previous inquiry into transportation service quality and economic development. Accessibility literature also is considered as the theory and application offer insight for addressing issues of spatial separation. Data sources drawn from for the index calculations are presented in the subsequent section. Section three is the presentation of data analysis and resulting indices. Conclusions and suggestions for future research comprise the final section.

LITERATURE REVIEW

The role of transportation in regional economic development often is treated as a passive factor. Transportation is, however, an intricate factor in the growth and development of economies. Weber (1899) and Von Thunen (1966) posit that transportation is a critical underlying facet in discussing spatial organization of an economy and the subsequent rates of economic growth that comprise it. In keeping with the mercantile-based ideals of spatial organization of Vance (1970), economic geography is defined by the transportation system and a composite of critical points of attachment that allows market economy to function efficiently.

In regional development literature, a limited amount of transportation research has been concentrated on investment in and availability of physical assets. The service q uality component of transportation has received little attention. In macro analysis of the relationship, public investment in infrastructure is found to positively impact private sector output and productivity for national economies (Aschauer, 1989). Others suggest disaggregate analysis may offer a more accurate representation of the relationship. They suggest that attention should be given the effects of marginal infrastructure investments, and the distribution of gains associated with these investments at sub-national level (Munnell, 1992).

Regarding physical infrastructure in rural areas, Fox and Porca (2001) conducted a meta analysis of previous research. They define infrastructure as services drawn from the set of public works that traditionally have been supported by the public sector. Five attributes of infrastructure are identified: accessibility, capacity, quality, diversity, and condition. They find that contribution of infrastructure investments, at the margin, have little effect on economic performance and that infrastructure may be seen as a competing means for enhancing rural economic environments. Suggesting that once a core transportation network is established, little causal evidence is attributed to additional transport infrastructure investment as a contributing factor in regional economic growth.

The European Conference of Ministers of Transport (2001) consider the value of transport in economic development to the extent it contributes to competition-based efficiencies in the goods market and employment-pool-based productivity in the labor market. The ECMT does not accept transportation investment as a casual factor in economic development. They find little empirical evidence to support the notion and suggest there are potential negative implications for disadvantaged, remote regions.

In their empirical assessment of the relationship between rural economy and transportation, Chandra and Thompson (2000) use regression analysis to test several hypotheses regarding the link between infrastructure investment and economic activity. Highways are the proxy for transport investment in their model. Results indicate initial construction-based economic benefits are accrued by adjacent counties. The longer-term regional effects seem to be a spatial redistribution of economic activity to adjacent counties from non-adjacent counties. These findings are not surprising, but provide little insight into multimodal issues or service-quality aspects of the relationship.

Other literature has concentrated on the spatial aspects of transportation under theories of accessibility and mobility. Although the terms often are considered interchangeable in planning, distinction can be made in definition and measurement (Ross, 2000). Mobility is "quantity of movement" that is rather easily measured by quantitative items such as per capita vehicle miles. Accessibility has an array of definitions that generally refer to a degree of spatial separation between a location and an opportunity, for which a standard measure is neither clearly defined or generally accepted. Although a finite definition of accessibility is not offered in the literature, in general it is the ability to connect in a network. Lithman (1999) defines access as "the ability to reach goods, services, activities, and destinations." Handy and Neimeier (1997) posit that "accessibility is determined by spatial distribution of potential destinations and the ease of reaching each destination, and the magnitude, quality, and character of activities found there." Neither seems a concise definition for defining the consummate measure of what continues to be a somewhat abstract notion.

Although little consistency is offered across accessibility measures, the basic properties of acceptable measures typically are based in axioms presented by Weibull (1976). The theoretical underpinnings are established so opportunity sequence is insignificant, individual behavior is rational, and opportunity influences measure is consistent across observations. Morris et al. (1979) offers pragmatic ideas for developing accessibility measures: that they consider socioeconomic factors, are economically feasibility, and may be readily interpreted. These accessibility notions provide a broad context to explore ideals such as economic competitiveness, in terms – of transport service quality, which is of interest in this research.

Accessibility models generally are defined by opportunity and impedance, with more complex models including individual behavior factors. Five functional forms of accessibility, each based in the spatial separation ideas, are travel-cost, cumulative opportunity, gravity, utility, and time-space (Handy, 1997; Bhat, 2000; Baradran and Ramjerdi, 2001; Bhat 2001;). Travel-cost is the least complex method where a measure of separation between location and a set of opportunity destinations indicates accessibility. Hansen (1959) measured accessibility as a location's average cost for reaching population, considering a linear distance function. In its first functional form, cumulative opportunity models use a limiter to define the spatial scope of opportunity for a location, such as distance or travel time. Gravity models add weights to opportunities for a measure that reflects potential interaction of masses. The cumulative opportunity, or gravity model, is the most oft employed measure of a potential interaction proxy for accessibility. The two remaining models, are utility and time-space. Utility models consider individual behavior and decision making. The time-space is even more complex because time-constraints set bounds in for the utility-based function, which includes mandatory and discretionary activities. While the theoretical basis for the latter two models is quite desirable, the data needs and modeling requirements for these models are often prohibitive, making consideration of the models as standard accessibility measures beyond the micro scale rather impractical.

For what? and for whom? are posed by Baradaran and Fariedah (2001) in their assessment of accessibility measures. In addition, this question should be posed: with what?, referring to the availability of resources such as time, funding, and existing data. Accessibility literature reviewed for this research primarily was based in serving the planning community and local issues, with limited attention given to policy issues. Accessibility measures have been used in urban planning and network assessment projects with the bulk of the literature concentrated on opportunity for and movement of individuals across space. In addition, localized studies in urban planning have employed accessibility measures to define and address issues such as land-use, socioeconomic discrimination, and congestion. Bhat et al. (2000) provide an excellent review of the ambit of this research. Consideration of accessibility measures in regional economic development is given limited consideration in existing literature (Keeble, et al., 1982; Vickerman, et al., 1999; Harris, 2001).

Keeble, et al. (1982) investigate the relationship between regional accessibility and economic growth in the European Community (EC) as it underwent geographic expansion between 1965 and 1977. An economic index is estimated to measure potential for economic activity across time and space. The geographic scope, measure definition, non-tariff and tariff trade barriers, and regional self-potential are detailed as critical parameters in the research. Geography of regions is based on an existing EC classification system. Rather than a typical centroid in the region, the authors chose the most economically important city as the node that defined the region for accessibility measures. Regional gross domestic product (GDP) is used as the measure of economic activity. A linear transport function, based on distance, is defined as the measure of impedance. The quantitative index of regional accessibility to economic activity is used as a comparative measure of regional advantage in economic growth, with calculation for alternative periods showing change over time. The authors find increasing disparity among regional access to economic activity between 1965 and 1973. The disparity continues to widen during 1973-77, but at a slower rate. Findings suggest that if accessibility – in terms of access to economic activity – is important to economic growth, the peripheral regions are becoming increasingly disadvantaged. This trend poses fundamental policy issues for influencing investment decisions and the potential for lagging regions to become more disadvantaged over time.

In a more recent study of the European Union, Vickerman et al. (1999) question the validity of the European policy to increase accessibility by establishing trans-European Networks (TENs) as a catalyst for economic growth. They offer population distributions and daily accessibility as indicators of accessibility considering the transport network. A gravity model is used to forecast populations for 2010, and a comparison is made to the 1993 distribution. The core is expected to gain, relative to hinterlands, in these estimations. Daily accessibility is measured by contact networks (Tornqvist, 1970). In this context, accessibility is measured by the population that can be reached from a city during a given period, such as a work day. Results suggest greater convergence between accessibility at the core and the periphery. The accessibility research provides important insights into network functions regarding distribution of achieved efficiencies generated by reducing the degree of spatial separation between entities. This research is complimentary to the ideas considered in development of the transport indices.

Harris (2001) offers a spatial approach to measuring accessibility that considers individual and competing locations. The consideration of relative position is an idea shared by the regional economic indexes of quantity and quality posed in this research. Harris suggests that the situation of a location in a region should be viewed not only in terms of its intrinsic characteristics, but also in its accessibility. Accessibility is a function of the location's access to opportunities over time. He offers that the relation of accessibility and competition can be considered in the context of the market. For instance, accessibility to jobs from a location may be measured in terms of average distance or time. The actual value of accessibility to the jobs from the location is diminished by competition, or accessibility of other locations to the same jobs. In his analysis, Harris measured accessibility in spatial terms using Euclidean distances between zone centroids for three classes of workers, considering location of home and location of workplace. Simple accessibility and three measures of competitive accessibility, in terms of total residences and total jobs, are considered. Harris finds that simple accessibility is weakly correlated with competitive accessibility. Therefore, he posits that accessibility and competitive accessibility are distinct. Three measures of competitive accessibility, including ratio, discounted and gravity values are highly correlated and one may potentially be selected as representative. Harris concludes that "accessibility is a quality of places that varies from place to place independent of any local conditions except connections with the rest of the region." The source of accessibility is not only the location of a population, relative to opportunity, but the location of other populations to the same opportunity. This idea is carried through in this research, as transport indicators compare quality among locations.

Research into the role of transportation in economic development has been largely confined to aspects of infrastructure. Although more recent literature regarding accessibility does have tangential information regarding the competitive advantage or disadvantage associated with spatial separation, this literature primarily is concerned with offering absolute measures for the spatial relationship between a location and an opportunity. The impedance factor in these measures is some indicator of ease of connection in terms of time or distance. The accessibility theory is adapted in this research to discuss the region's transportation resources as a factor in ability of that region to grow its economy.

The region's transportation resources are an important factor for understanding the relative position a region holds as it seeks to integrate its goods and labor force in a global marketplace. Although distance often is a critical factor in this relationship, it may not provide best representation of the competitive position of a location in terms of its transportation resources. Research suggests that those regions lagging in terms of accessibility continue to do so at an increasing rate. Transportation is a critical yet opaque factor in this accessibility.

The balance of this research offers methodology to use existing data sources as proxies in a representation of regional transport quality. Two indexes will indicate the relative position of a non-metropolitan city-center's freight transport and business-traveler transport resources. The information will be useful in local investment, planning, and policy decision as well as in national discussions about rural economic development investments and programs.

DATA SOURCES AND INDEX COMPOSITION

Transportation resources are a fundamental consideration as cities seek to attract and grow businesses for economic development. Large metropolitan centers generally benefit from natural and a gglomeration advantages in of transportation, considering availability of services and competitive transportation rates. Transport problems for these cities largely are concerned not with linking transportation and economic development as "connectivity for global market interactions," but with micro-case planning and intra city issues such as congestion, socioeconomic discrimination, and land-use. Transport systems are a cumulative set of natural and man-made resources that were established mainly during the agricultural and industrial eras. In today's information age, it is prudent to offer ongoing critical assessment of transport resources in the context of dynamic market parameters. The purpose of this research is not to measure the absolute level of transportation quality or to add yet another measure of accessibility to the existing array. Rather, it is to develop two indicators which reflect the relative, or competitive, quality of a non-metropolitan city's intercity transportation relative to other non-metropolitan cities. Resources are mobile in the United Sates, responding to signals from our knowledge-based economy with migration and investment. Natural or m an-made transport resources may offer regions a competitive advantage, attracting resources to spur economic development.

The three questions posed in the review of accessibility literature, for what? for whom? with what? underlie the approach used in estimating the regional economic transport indicators for this research. The goal of this research is to define and present transport indicators that can be employed by decision makers involved in regional economic development of non-metropolitan cities and their surrounding regions. The indicators are to provide a measure of the relative quality of transportation available for an individual non-metropolitan U.S. city relative to other non-metropolitan cities in the contiguous 48 states. Therefore, the measure must be standardized across time and space. In addition, it is desirable that the calculation of this index be replicable as new data becomes available. The value of the index is not only in the static information it provides concerning an individual city's transport resources at a point in time, but for information on shifts and trends in the relative quality and quantity of resources for the city's transport resources relative to those of other cities and regions. That information will provide decision makers with a system for continued insight to evaluate strengths and weaknesses in their transport resource base, a resource on which they depend to compete in regional and global markets.

Data Sources

Two indices are designed to reflect the quality of freight transport and business traveler transport for non-metropolitan cities. Three primary freight modes, truck, rail, and water, are considered in the freight transport indicator. Other sectors such as airline and pipeline do serve small segments of the freight market, but the share for these modes is estimated to be less than 1 percent and 3 percent, respectively (Bureau of Transportation Statistics, 2000). Due to the limited representation of these modes in overall freight flows, they are not considered in this research.

Regarding the proxies for the relative quality of freight transport available for a non-metropolitan city, statistics that characterize freight transport in terms of volume, capacity, and service rates are considered. Volumes provide information about the level of activity. In the context of new growth theories, higher levels of activity allow for agglomeration economies as business and consumers benefit from the efficiencies of size and convenience. Capacity may be a consideration in the quality of freight transport, in terms of reliability and pricing competition. Carriers' freight service rates offer another source of information about the effectiveness of competition in transport pricing. Although overall capacity and utilization may be factors in transport pricing, service rates offer a more comprehensive indicator as they encompass other market parameters, such as the effects of intramodal, intermodal, geographic and product competition. Criteria for selection of non-metropolitan cities and the data sources draw from in developing the quality measures for these cities are detailed in the remainder of this section.

Non-Metropolitan City Delineation

The U.S. population has become highly urbanized, with approximately 79 percent of residents living in urban areas in 2000 (U.S. Census, 2000). Nearly 85 percent of the U.S. population resides in counties with at least one metropolitan area.[1] While urbanized counties house a substantial share of U.S. residents, nearly half of the U.S. land area consists of non-metropolitan and rural counties (Economic Research Service, 2002). This land area and the cities located in these rural areas are critical components in national economic landscape, considering social and transport networks.

Non-metropolitan communities, those with populations of 25,000 to 249,999, account for about three-quarters of the U.S. non-metropolitan population. In the west, these non-metropolitan communities are even more prominent with 82 percent of the non-metropolitan residents living in small urban areas. The trend in urbanization is evident in the story chronicled by the U.S. Census Bureau. The U.S. population has clearly migrated toward urban areas over the past century as illustrated in Figure 1 (U.S. Census, 2002 and 2003). As these non-metropolitan communities are attributed with a majority of the population growth in rural areas over the decade, it seems prudent to consider the transport resources available for building the economies of these cities as nexus in regional economic growth.

To ascertain information about the transportation quality of these cities, a subset of counties is selected from the U.S. population of cities, considering city population and county proximity to a metro area. The definition of rural or non-metropolitan is not concise among sources, but generally follows the definitions of Office of Management and Budget (OMB) and the U.S. Census Bureau (Census Bureau). The Census Bureau uses the term Urbanized Area (UA) to refers to urbanized population centers of 50,000 or more. The UA may be confined to a single county or defined by a group of counties. Under the standards, the county (or counties) in which at least 50 percent of the population resides within urban areas of 10,000 or more population, or that contain at least 5,000 people residing within a single urban area of 10,000 or more population, is identified as a "central county" (counties). OMB used the urbanized area delineation in its baseline criteria for definition of Metropolitan Statistical Areas (MSA). An MSA is comprised of UA with a population of with at least 50,000 or more and a total MSA population of 100,000 or greater. The MSA population includes the central city-county

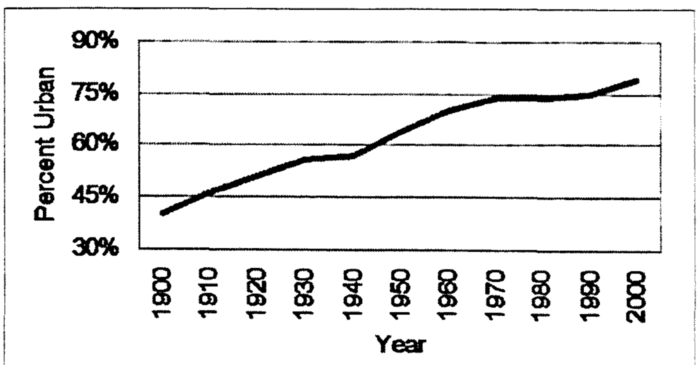

Figure 1. Urban Population as Share of Total U.S. Population

[1]Counties with, and adjacent to, cities of populations greater than 250,000.

population, along with the population of any contiguous counties that socially and economically are integrated with the central city-county. These MSA are further categorized into four population levels, Level A: areas of 1 million or more; Level B: areas of 250,000 to 999,999; Level C: areas of 100,000 to 249,999; and Level D: areas of less than 100,000 (OMB, 1999). Communities in Levels C and D, that are not contiguous to Level A, are the focus for this research.

Cities are classified into four population-based categories for this analysis. The 2000 U.S. Census Bureau population estimates are used to define the city categories. Megapolitans are cities with populations over 500,000. Metropolitans are cities with populations between 250,000 and 499,999. Small urban centers and towns are cities with populations of 25,000 to 250,000 and fewer than 25,000 residents, respectively.

The Economic Research Service (ERS) offers useful extensions of the OMB rural/urban delineation in three classifications it has devised. These extensions include the Urban-Influence Code, Rural-Urban Commuting Zone, and Rural-Urban Continuum Code. The Rural-Urban Continuum Code (also commonly know as the Beale Code) classifies U.S. counties by size of the urban place and nearness to a metropolitan area. The nearness or adjacency factors are that it (1) is physically adjacent and (2) has at least 2 percent of the employed labor force in the non-metro county commuting to the central metro counties. This classification is adapted to select the subset of counties containing non-metropolitan cities from the set of all U.S. counties. The ERS Beale Code classification is used to categorize counties in this research because it considers proximity to metro population areas and because it offers codes for counties with metro areas of populations under 250,000. The classification codes are based on 2000 U.S. Census data. Classification for the Rural-Urban Continuum Code and distribution of counties across the codes is presented in Table 1. Details of other classifications are available from the ERS.

Table 1. Rural-Urban Continuum Codes for Counties in the Contiguous 48 States, 2000

Code	Description	Percent of U.S. Counties
Metro Counties		
1	Counties in metro areas of 1 million population or more.	13
2	Counties in metro areas of 250,000 to 1 million population.	10
3	Counties in metro areas of fewer than 250,000 population.	11
Nonmetro Counties		
4	Urban population of 20,000 or more, adjacent to a metro area.	7
5	Urban population of 20,000 or more, not adjacent to a metro area.	3
6	Urban population of 2,500 to 19,999, adjacent to a metro area.	19
7	Urban population of 2,500 to 19,999, not adjacent to a metro area.	14
8	Completely rural or less than 2,500 urban population, adjacent to a metro area.	8
9	Completely rural or less than 2,500 urban population, not adjacent to a metro area.	14

Source: Economic Research Service, 2003

The focus cities for this research are identified using a combination of the OMB city and ERS county classifications. The subset of counties containing non-metropolitan cities is defined as the group of counties classified with Rural-Urban Continuum Codes 3 and 5. Cities and their respective counties selected from this group are those with a city population of 25,000 to 250,000 in a county that is not adjacent to major metro county, having a population of one million or more. City population data for 2000 was obtained from the U.S. Census Bureau to make the selection (2003). These cities and their county are termed "mesocities" for the balance of this report. The cities with populations from 25,000 to 250,000 in counties adjacent metro counties – counties classified as Rural-Urban Continuum Code 4 – are excluded from the mesocity population as economic inertia generated by the neighboring metropolitan area may be an overriding factor in the transportation quality of these cities. Suburbs are an example. Often, these cities are primarily residential neighborhoods with some service industry with their economic growth largely determined by the labor market in the neighboring metropolitan city.

It is necessary to consider the county in conjunction with the city population as few sources of consistent and statistically valid data for cities in this population category. These cities and their associated 209 counties represent 29 percent of the non-metropolitan land area in the United States and comprise 74 percent of non-metropolitan population in 2000. The locations of these cities are illustrated in Figure 2, and a list is included in Appendices A and B. It is estimated that these mesocity counties accounted for more than 60 percent of the population growth in non-metropolitan areas between 1980 and 2000 (U.S. Department of Commerce, 2002). In accordance with national migration trends, these statistics provide evidence that rural populations have become more concentrated over the past two decades. This research offers insight into the freight and business resources transportation resources associated with economic development in this substantial rural population segment.

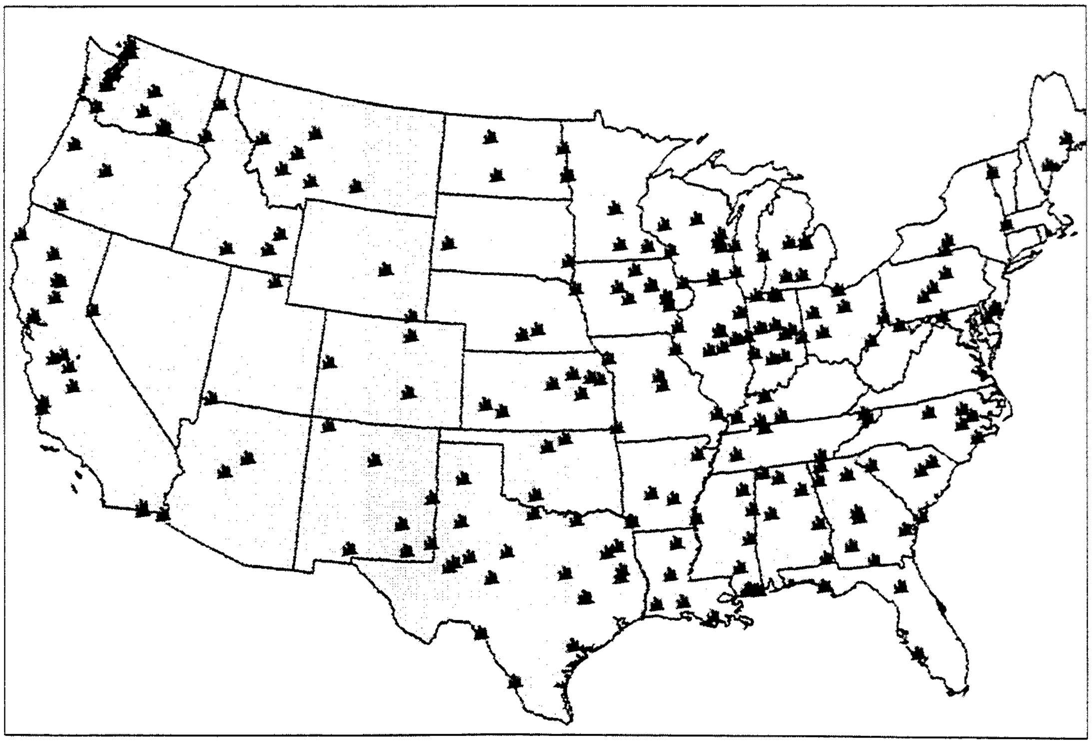

Figure 2. U.S. Mesocity Locations

Freight Transport Data for Non-Metropolitan Cities

Characteristics of cities, such proximity to markets and modal availability, provide some information about transport resources. In addition, survey-based freight statistics are published by the U.S. Census Bureau and the Department of Transportation's Bureau of Transportation Statistics at several geographic strata. The strata vary by data source, but for national data most are aggregated at the state level to ensure confidentiality and statistical reliability. Although some information is published for larger population centers, detailed information about the transport for freight originated from many non-metropolitan cities is not available at the local level. Therefore, local characteristics will be combined with national and regional transport data sources to estimate freight transport quality.

As mentioned, the quality of service for general freight shipments will consider truck, rail, and water alternatives. Although air and pipeline options are available, less than 4 percent of U.S. freight is transported via these modes. Furthermore, goods moved via air and pipeline typically have unique characteristics such as perishability and customized logistics systems that are not reflective of general freight movement channels.

Three primary data sources are used in the assessment of freight transport service quality. The first data source is the 1997 Commodity Flow Survey (Bureau of Transportation Statistics, 2000). The 1997 Commodity Flow Survey (CFS) is a continuation of the Commodity Transportation Survey conducted from 1963 to 1997. It provides an estimate of modal distribution and shipment characteristics, such as distance, weight, and value for freight originated by about 800,000 domestic businesses. The 1997 CFS is a summary of data collected from a sample of 100,000 of these businesses. Although the CFS data is criticized for lags and gaps, it generally is recognized as an important resource for investigating U.S. transportation patterns. It is the primary source of public information for multimodal national data analysis.

An important source of rail industry data is the U.S. Public Use Waybill Sample (Surface Transportation Board). An overall sampling rate of approximately 2.8 percent is used to compile the annual waybill sample information. Information is collected from the population of U.S. Class I and large short line rail shipments using a stratification procedure based on shipment size. The system is designed to elicit representative shipment information for the rail industry (Association of American Railroads, 2002). The Waybill Sample included an average 577,000 observations between 1999 and 2001.

Valuable insight could be gained by joining baseline multimodal information from the CFS, such as modal shares and state freight volumes, with rail rate and shipment information available in the Waybill Sample database. Two challenges had to be overcome in relating these data sources; first, selecting the geographic level of stratification and finding a common denominator in the data sources; and second, converting one of the two data sources into a new commodity classification system.

State-level freight summaries were available for the CFS, while the Waybill uses Bureau of Economic Analysis (BEA) regions. The BEA regions follow county lines, but disregard state borders. State-level estimates of rail traffic, based on the Waybill data, were created by distributing BEA volumes across counties based on county-BEA land area ratios.

Regarding the commodity classification, the Standard Classification of Transportation Goods (SCTG) categories were chosen for this research. The Waybill data uses the Standard Transportation Commodity Classification (STCC) freight class identification system, while the CFS uses the SCTG system. A preliminary bridge between the two data sources was obtained to estimate rail rate information at the two-digit SCTG level (Bureau of Transportation Statistics, 2003). SCTG rates were estimated for each BEA at the two-digit SCTG level. The same rate was then applied to each county in the BEA. The estimated state-level rates for two-digit SCTG commodity classes are weighted average calculations of county rates. The weight is based on the estimated county rail Waybill volume.

The U.S. Department of Commerce *Vehicle Inventory and Use Survey* (VIUS) also is accessed as a data source (2000). The trucking industry is highly competitive, with largely mobile resources that move freely in and out of markets with relative ease. It is difficult to gauge the availability of truck service across regions. The VIUS includes a profile of the nation's truck population based on state commercial truck registration data. Although annual registration practices vary among states, a common denominator is used to standardize information. For example, some states register tractor-semitrailer units as a single unit and others register the tractor and semitrailer separately. To standardize, only the power units are counted in the VIUS. The survey offers information about the location of truck capacity across states, based on vehicle registrations. In addition, it provides a means for examining the effects of policy and institutional changes as they are reflected by shifts and trends in state vehicle registrations.

The National Transportation Atlas Database (NTAD) is a primary information source for consideration of water transport quality among the mesocities. Energy, agriculture, and chemical are dominant industries in the use of water for goods transport (Bureau of Transportation Statistics, 2000). The NTAD database was enlisted to identify water terminals that reported food products, coal, grain, or chemicals as the primary cargo. These four cargos were selected for their relatively high usage of water transport – all are in the 75th percentile for share of product shipped via water. Location of the 430 water terminals included in the dominant-water-user industry terminal geography are identified in Figure 3. The Census Bureau and Department of Transportation data source described in this section proved the statistical basis for the freight indicator computation. The CFS, Waybill, and VIUS data publications provide insight into modal use and competition for freight originated in mesocities. The use of these sources provides the opportunity for

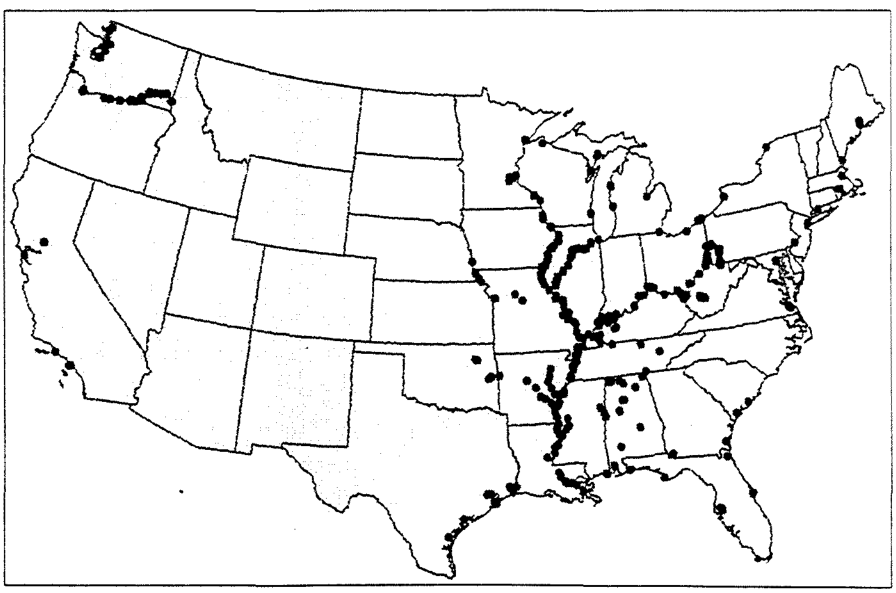

Figure 3. Dominant Industry Water Terminal Locations

replication and additional sub-national assessment of freight transportation service available to businesses located beyond the range of large metropolitan centers.

Business Traveler Transport Data for Non-Metropolitan Cities

Other data sources used in this research are related to business traveler transport. As the cities considered in this research are non-metropolitan centers, it is assumed that the cost of intercity travel is a good proxy for the quality of business traveler transport. Although telecommunications, including videoconferencing, facsimile, and electronic mail offer substitution for travel, it seems unlikely that these methods of interactions will supersede automobile and air travel (Stephenson and Bender, 1996). In fact, it has been suggested that telecommunications and travel are positively correlated, as increasingly effective and efficient communication may stimulate travel demand by increasing business activity (Khan, 1987; Mokhtarian, 1990; Gaspar and Glaeser, 1998).

The two intercity business traveler modes considered in this analysis are automobile and airplane. A delineation of the distance at which the modes are interchangeable is a one-way distance of 250 to 300 miles, based on previous research (Stephenson and Bender, 1996; Bureau of Transportation Statistics, 1 997; Sharkey, 2003), is considered in discussing the quality of business travel.

Two data sources are employed to develop an index for the quality of business travel for non-metropolitan cities. The *National Transportation Atlas Database* provides a directory of U.S. airports including information about location, equipment, and annual activity (Bureau of Transportation Statistics, 2002). The Department of Transportation *Domestic Airfares Consumer Report* is the source for airfare and flight distance information (2003). The *Domestic Airfares Consumer Report* is a 10-percent sample of all airline tickets in the country. Flight distance from origin city airport to large hub airport is the proxy for the 300-mile automobile substitution measure.

Because a complete set of airfare data is not available, a regression model of airfares is developed to better understand business traveler transport. Quarterly fares data from 2000 through 2002 are considered in a model of business traveler air fares. Average airfares to hub airports from all cities included in the quarterly fare data are included in the data set. The classification system under 29 U.S.C. §41713(a)(3) identifies large hub airports as facilities that are publically owned and handle at least 1 percent of annual passenger boardings (U.S. Department of Transportation, 2003). The hub airport locations are illustrated in Figure 3. The airport profile and fare information is employed in a regression model of U.S. air fares. The airfare model supports the use of distances as a proxy in the assessment of mesocity business traveler transport quality, as limited information is available for a nationwide comparison of fares and services available at the city level.

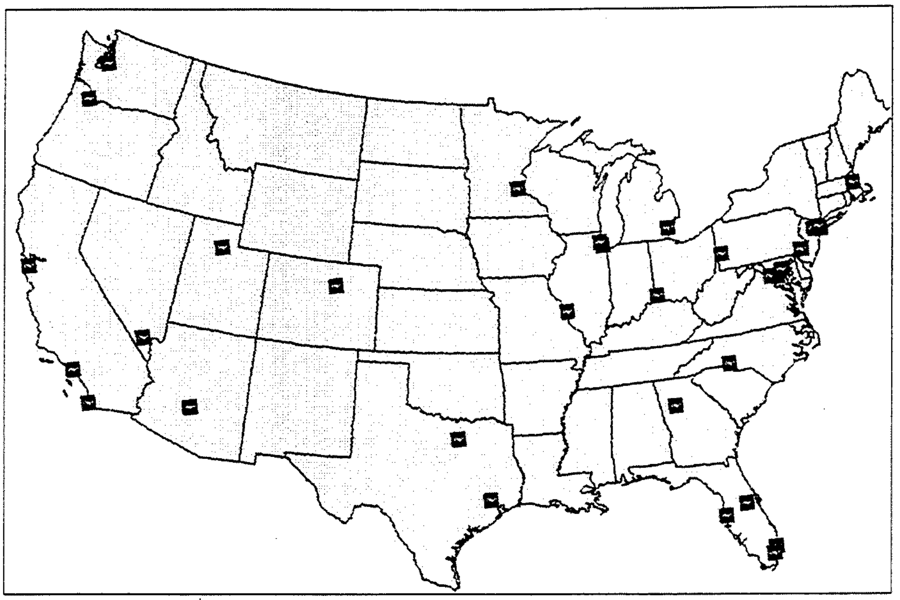

Figure 4. Hub Airport Locations

Index Composition

The freight and business transport quality indices are composed of several components that indicate relative quality in the mesocity population. The freight quality index is a composite quartile indicator with rail rate, truck capacity, and water access components. The business traveler quality index is a quartile indicator, which reflects the quality of service, in terms of hub airport proximity. Air travel is a primary mode for longer distance business travel and the focal factor used to assess the quality of business travel available as an economic development resource. Details of the components that make up the two indices are presented in the results section.

RESEARCH RESULTS

Mesocities, those cities with populations from 25,000 to 250,000, which are not adjacent to major metropolitan centers, are located across more than 200 counties in the United States. These cities are focal points in the rural socioeconomic landscape as they account for approximately three-fourths of the total non-metropolitan population in 2000. Furthermore, mesocities and their associated counties attributed 60 percent of non-metropolitan area growth over the past two decades. The following research findings provide these populations centers with valuable information regarding the relative position of the quality of transportation services they can offer in pursuing economic development opportunities. A combination of state-level and mesocity-level data is used in proxies describing the transportation service quality available among city-centers located in non-metropolitan areas. The information provides a baseline for assessing the current and future resource allocations toward transportation services.

Transportation Quality Indices

The transportation quality indicators are quartile-based assessments of the freight and business transport resources available to mesocities. The freight quality indicator is a composite of rail, truck, and water service measures. The CFS, Waybill, NTAD and VIUS data source are included in the calculation of the indicator. The individual modal service measures are combined in the overall composite freight service indicator by weighing the influence of individual modal services in accordance with the CFS modal share information. The indicators, and their composition, are detailed in this section.

Service Diversity

Initially, an overall indicator of freight diversity is presented. Freight diversity offers an indicator for the level of modal competition influencing the current distribution and use of freight transportation resources. With the transportation industries largely deregulated over two decades ago under the Staggers Act and its predecessor legislation, market competition is the primary factor in transportation quality, including rates and service. The diversity index is based on a Herfindahl Index of industry concentration. The equation is stated as,

$$H = \sum_{i=1}^{m} X_i^2$$

where m = mode share i, for modes truck, rail and water, and
X = modal share in state

The modal diversity scale range is from 0 to 1, with 1 indicating modal monopoly. The overall U.S modal diversity index is 0.52 considering the three primary modes, truck, rail, and water. The lower, mid, and upper quartiles of diversification defined by the 25th, 50th, and 75th percentiles, respectively for distribution of the modal diversity indicators across the 48-contiguous states are at the index levels of 0.48, 0.58, and 0.75, respectively. The state-level diversity categorization is illustrated in Figure 5. The high concentration of truck use in the Northeast is evidenced by the cluster of states with a diversity index in the upper quartile or 75th percentile. Trucks handle more than 93 percent of the freight originated from Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island, and Vermont, considering tons originated by the three primary modes (Bureau of Transportation Statistics, 2000). State clusters in the northern and southern plains, along with Utah, Illinois, Kentucky, and West Virginia have the most diversity in modal usage for freight originations. The range of diversity may be a function of factors including freight characteristics, customer demands, institutional differences, and the base of natural and man-made transport resources.

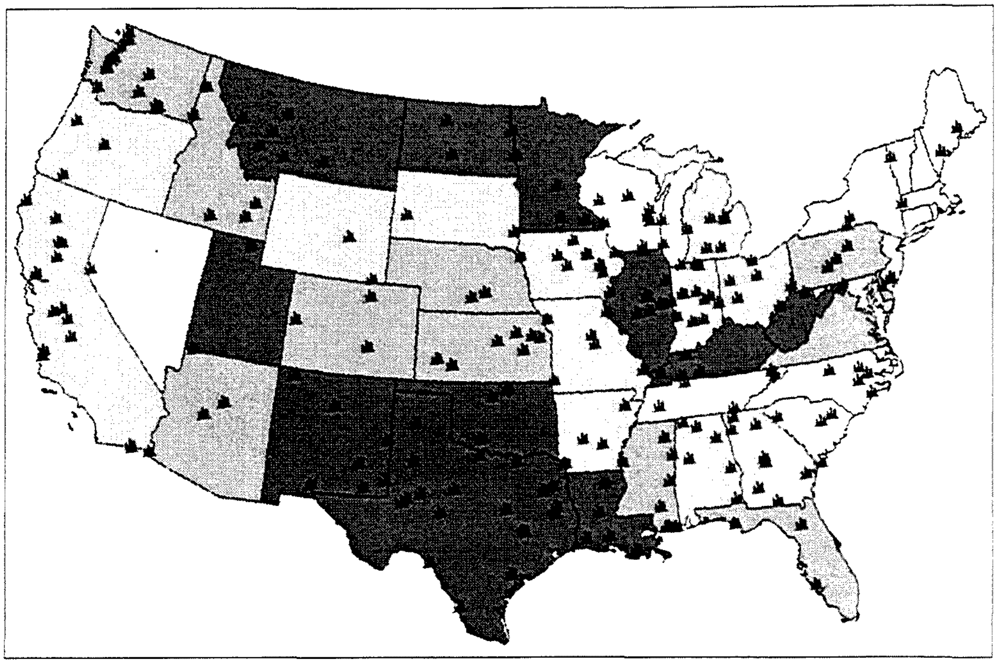

Figure 5. Modal Freight Diversity and Mesocity Locations (Darker indicates more Freight Diversity)

Freight Service

The first major transport quality indicator discussed is the freight-quality indicator. The freight-quality indicator includes truck capacity, rail rate, and water distance as proxies for service quality among the primary modes. The quartile-based assessment of the indicators among states is weighted by the state modal origination shares. The state-level quartile delineations offer mesocities some insight into transportation resources by providing a measure of the relative position of individual state transportation resources, compared to other states. These state-based indicators may be beneficial in assessing future policy and investment strategies for economic development of mesocities and their regional economies.

The composite freight-quality indicators, based on quartile distribution, are illustrated in Figure 6. Mesocities located in several plains and western states, including Idaho, Iowa, Montana, Kansas, Nebraska, North Dakota, South Dakota, Oklahoma, and Wyoming, have the highest-quality freight based on the composition index estimated in this research. A cluster of freight- disadvantaged mesocities is indicated in the northeast region along with mesocities in Florida, Tennessee, and Texas. The freight-quality indicator for mesocities in these states is in lower quartile, or 25th percentile. The quality indicators for the individual modes used in the composite freight-quality measure are included in Table 2.

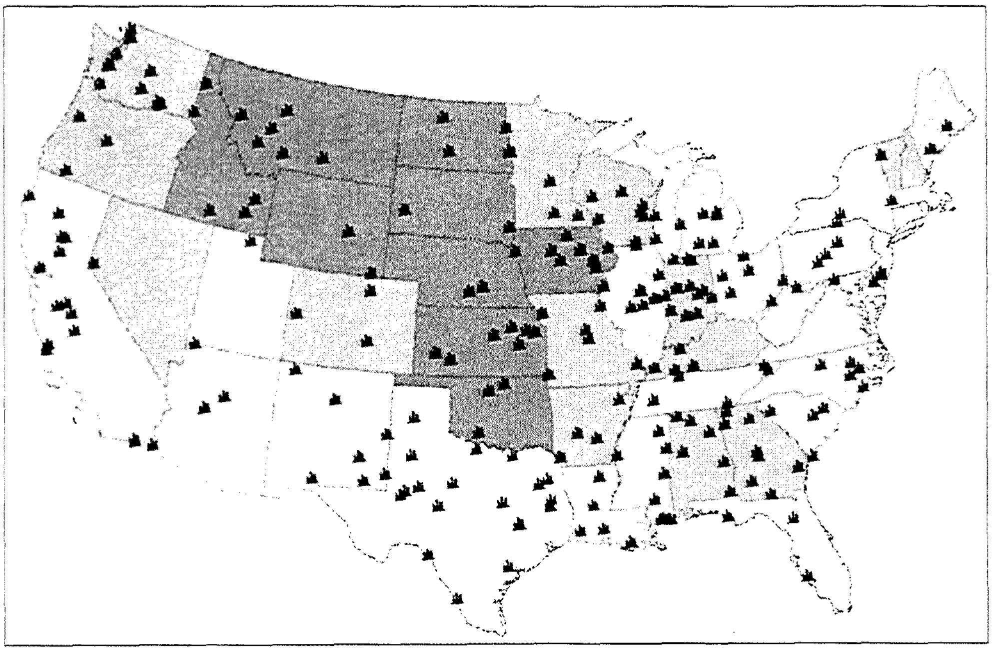

Figure 6. Freight Quality Indicator for Mesocity Locations
(Darker color for Higher Quality Indicator)

Table 2. Freight Transportation Diversity and Quality Indicators

State	Freight, Modal Diversity Index[1,2]	Individual Modal Quality Indicators: Rail	Truck	Water	Composite Freight Transportation Quality Indicator
		Quality Quartile 1= more positive to 4=more negative for overall quality			
Alabama	3	2	2	1	2
Arizona	2	4	3	4	3
Arkansas	3	3	2	2	2
California	3	2	3	3	3
Colorado	2	1	2	4	2
Connecticut	4	4	4	1	4
Delaware	2	3	3	2	3
Florida	2	4	4	1	4
Georgia	3	3	2	2	2
Idaho	2	2	1	4	1
Illinois	1	3	3	1	3
Indiana	3	3	2	2	2
Iowa	3	1	1	2	1
Kansas	2	1	1	4	1
Kentucky	1	1	2	1	2
Louisiana	1	3	3	1	3
Maine	4	*	2	1	1
Maryland	3	4	4	2	4
Massachusetts	4	4	4	3	4
Michigan	3	4	3	1	3
Minnesota	1	1	2	2	2
Mississippi	2	3	3	1	3
Missouri	3	3	2	1	2
Montana	1	1	1	4	1
Nebraska	2	1	1	3	1
Nevada	4	1	3	3	3
New Mexico[2]	4	2	2	1	2
New Jersey	3	4	4	1	4
New York	1	4	2	4	2
New Hampshire	4	4	4	3	4
North Carolina	4	3	3	3	3
North Dakota[2]	1	1	1	4	1
Ohio	3	4	3	2	3
Oklahoma	1	2	1	3	1

Table 2. Freight Transportation Diversity and Quality Indicators *(continued)*

State	Freight, Modal Diversity Index[1,2]	Individual Modal Quality Indicators: Rail	Truck	Water	Composite Freight Transportation Quality Indicator
		Quality Quartile 1= more positive to 4=more negative for overall quality			
Oregon	3	2	2	3	2
Pennsylvania	2	2	4	3	4
Rhode Island	4	3	4	2	4
South Dakota	4	4	2	3	2
South Carolina	3	1	1	4	1
Tennessee	4	2	4	2	4
Texas	1	2	4	4	4
Utah[2]	1	1	3	4	3
Vermont	4	3	2	3	2
Virginia	2	4	2	1	2
Washington	2	2	2	1	2
West Virginia	1	2	3	1	3
Wisconsin	4	3	2	2	2
Wyoming	3	1	1	4	1

[1]Diversification of single mode traffic volumes (Commodity Flow Survey, 1997).

[2]On average, 94 percent of the freight originated in states was shipped via single mode. States in the 25th quartile, include ND, NM, and UT that report only 70, 68, and 58 percent of freight via single mode. "Unknown" is the most common mode category for freight not reported under single mode.

Note: Index Weights and Values included in Appendices C and D.

Truck Indicator

Discussion of the individual modal indicators begins with trucks, as it is the dominant mode in U.S. freight transport. U.S. demand for truck service has increased during recent decades in response to consumer product demands and business inventory management practices. The truck industry offers few data sources for assessing competition and associated service quality. As truck capacity often is an important factor in attracting freight-based economic development, a ratio of for-hire trucks to state population is used as a proxy for truck quality in terms of capacity.

The U.S. truck fleet includes more than 68 million vehicles (U.S. Census Bureau, 2000). The primary use for more than 70 percent of these vehicles is personal use. The balance of the truck fleet is dominated by business-use trucks, with the remaining 4 percent of the fleet categorized as for-hire, daily-rental, and mixed-use.

The U.S. ratio of population to freight truck capacity is 15.1, including trucks that are categorized in the VIUS as business-use, for-hire, and daily-rental in estimating the available truck fleet. The geographic distribution of population and freight truck capacity is highly correlated at the state level (r=.95, p=.000). State-level truck capacities range from a high of 30.5 to a low of 5.1. Trucks are a highly mobile and flexible freight transportation resource so regional information may offer another benchmark for assessing truck freight.

The population-freight truck ratio varies across the four U.S. census regions. Census regions are defined by grouping states into four national regions as illustrated in Figure 7. The Midwest and West have the lowest population-freight truck ratios of 13.2 and 13.5, respectively. The Northeast has the least attractive ratio among the four regions. The South is at the national average with a ratio of 15.1. These ratios suggest that truck capacity is nearly 40 percent less in the Northeast region compared to western regions' capacity.

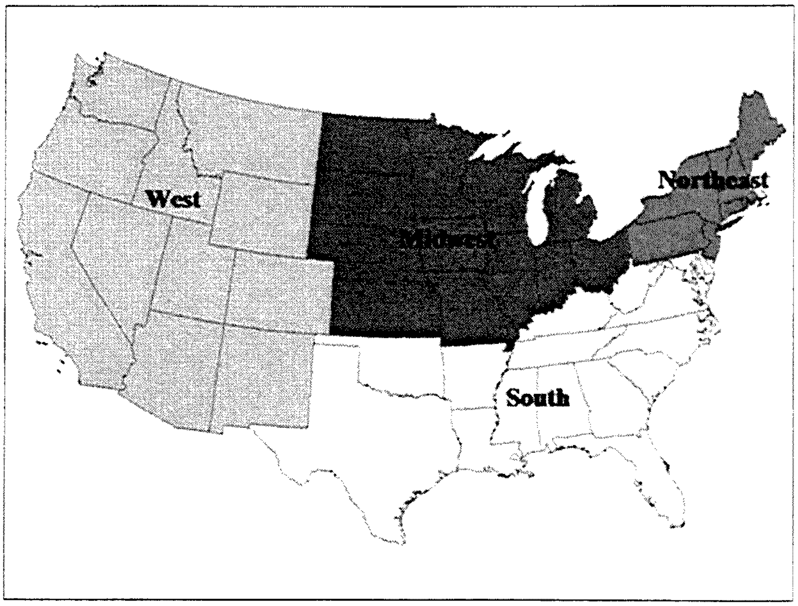

Figure 7. U.S. Census Regions

Table 3. U.S. Population-to-Truck Ratios

	Population	Total Trucks	Total Freight Trucks	Population-to-Truck Ratio
Northeast	53,594,378 19%	9,702,005 14%	2,403,275 25%	22.3
Midwest	64,392,776 23%	17,085,976 25%	4,886,900 29%	13.2
South	100,236,820 36%	24,239,298 35%	6,634,210 27%	15.1
West	61,359,463 22%	17,313,760 25%	4,557,440 26%	13.5
U.S. Total	279,583,437	68,341,039	18,481,825	15.1

Data Source: U.S. Census Bureau, 2000 and 2003.

Rail Indicator

The rail quality indicators are based on the freight rate data reported in the Waybill Sample between 1999 and 2001. As with trucking, deregulation of the rail industry has encouraged more market-based pricing with differentiation based on commodity characteristics and the competitive environment. A wide variation in both use of rail in shipping and rail rates paid is illustrated by the average rate paid among two-digit SCTG commodity classes (Table 4).

Table 4. Modal Shares, Rail Rates, and Rail Distances, by SCTG Commodity Class

Commodity Class	Million Tons	Modal Shares* Truck	Rail	Water	Multi & Unknown	Avg. Rail Revenue per Ton Mile	Avg. Rail Distance
Live Animals	6	100%	0%	0%	0%	n.a.	n.a.
Cereal Grains	490	45%	29%	18%	8%	3.30	832
Other Agricultural Products	202	72%	9%	16%	2%	4.65	925
Animal Feed & Products	220	90%	8%	2%	0%	4.58	802
Meat, Fish, Seafood	79	98%	1%	1%	0%	5.54	1,534
Milled Grain Products	103	82%	17%	0%	1%	5.26	772
Other Prepared Foodstuffs	397	90%	8%	1%	1%	5.17	950
Alcoholic Beverages	81	89%	10%	0%	0%	4.51	1,089
Tobacco Products	4	100%	0%	0%	0%	3.37	1,640
Monument & Building Stone	16	100%	0%	0%	0%	2.78	961
Natural Sands	443	95%	2%	2%	0%	5.05	416
Gravel And Crushed Stone	1,815	94%	3%	3%	0%	5.08	221
Nonmetallic Minerals N.E.C.	236	74%	15%	7%	7%	4.48	388
Metallic Ores & Concentrates	91	20%	47%	7%	28%	4.47	221
Coal	1,217	22%	56%	6%	16%	2.87	630
Gasoline & Aviation Turbine	963	54%	1%	8%	75%	6.40	258
Fuel Oils	482	52%	1%	11%	69%	4.86	834
Coal & Petroleum Products	475	62%	13%	15%	20%	5.43	653
Basic Chemicals	296	44%	28%	16%	22%	5.76	863
Pharmaceutical Products	10	97%	0%	0%	4%	5.94	1,443
Fertilizers	179	55%	36%	5%	5%	5.49	599
Chemical Products	92	90%	7%	0%	3%	5.83	732
Plastics & Rubber	130	80%	19%	0%	1%	7.44	920
Logs & Other Rough Wood	371	97%	2%	0%	1%	4.96	338
Wood Products	329	87%	11%	0%	2%	4.67	1,028
Pulp, Newsprint, Paper	152	72%	26%	0%	2%	5.13	1,086
Paper Or Paperboard Articles	74	98%	2%	0%	0%	7.02	1,218

Table 4. Modal Shares, Rail Rates, and Rail Distances, by SCTG Commodity Class *(Continued)*

Commodity Class	Million Tons	Modal Shares* Truck	Rail	Water	Multi & Unknown	Avg. Rail Revenue per Ton Mile	Avg. Rail Distance
Printed Products	78	99%	0%	0%	1%	9.86	1,365
Textiles, Leather	46	99%	1%	0%	1%	8.85	1,524
Nonmetallic Mineral Products	910	96%	2%	1%	0%	5.40	632
Base Metal Primary/Semifinish	336	83%	15%	1%	1%	5.00	768
Articles Of Base Metal	107	93%	5%	0%	2%	6.52	701
Machinery	50	97%	2%	0%	1%	11.14	1,241
Electronic & Other Electrical	40	97%	1%	0%	4%	11.27	1,493
Motorized & Other Vehicles	98	83%	14%	0%	3%	17.84	806
Transportation Equipment	5	59%	32%	0%	11%	14.73	872
Precision Instruments	3	94%	0%	0%	11%	10.91	1,770
Furniture, Mattresses	20	99%	1%	0%	0%	11.10	1,673
Miscellaneous Manufactured	112	98%	1%	0%	1%	10.75	1,369
Waste And Scrap	178	74%	23%	2%	1%	6.37	517

Source: Bureau of Transportation Statistics, 2000; Surface Transportation Board, 1999-2001
n.a. = not available
Modal Shares calculated by Tons.*

The rail industry quality indicator reflects the quartile for the estimated revenue per ton mile paid for rail service for commodities originated in the state. The average revenue per ton mile paid by states average from $0.0295 to $0.1357. The median per ton mile payment is $.0528. Given the market-based pricing for rail rates and the wide variation of rates across commodities, additional information about the relative competitiveness of rail rates among the states may provide important insight for assessing mesocity transportation resources.

Several natural resource-based commodities have innate qualities, such as homogeneity and low-value-to-weight ratios, that allow economies for large-volume shipments in trains and barges. Because the commodities have unique features, they are likely associated with a unique rate structure. The difference in rate structures is evidenced by the distribution of revenue per ton mile (RPTM) comparing commodities in the natural resource classes to other commodities (Figure 8). The proportion of these commodities in the overall rail rate for a state may distort perceptions about rail prices paid for shipping natural-resource-based products compared to other products. The commodities identified as natural-resource-based are those for which average rate for all shipments between 1999 and 2001 was in the 25th percentile when two-digit SCTG commodity class rates are estimated. The four commodities with relatively low rates are coal, cereal grains, fertilizers, and metallic ores. The average

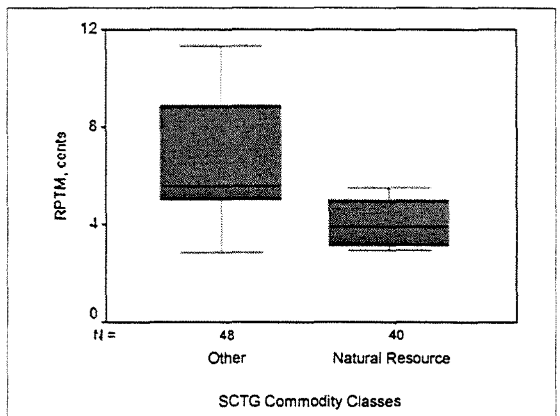

Figure 8. Lower Quartile versus Other SCTG Commodity Classes, 1999-2001 Average RPTM Distribution

revenue-per-ton mile is $0.0403 for the natural-resource classes, which were identified by their relatively high utilization of rail, compared to $0.0692 for other commodity classes.

In addition to an overall index for rail rates, it seems prudent to provide additional insight into the rail quality measure. Grouping commodities based on their rail use at the two-digit SCTG commodity classification level provides greater insight into the aspects of rail service quality. The lower-value, bulk movements such as natural resource goods and higher-value semi-processed and manufactured goods face differing parameters in investment decision arenas. The higher-value goods are more often associated with footloose industries. Attracting higher-value industries is not based in fixed resources such as land and mineral deposits, but in mobile resources such as labor and knowledge. The ability of mesocities to differentiate themselves based on the quality of rail services for different industry segments is important. The information also is useful as regions consider investments and assess policy that will influence the role of rail transport in its economy. The quality of rail quality for natural-resource commodities is compared to that of other commodities in a state-level illustration (Figure 9). States in the central and

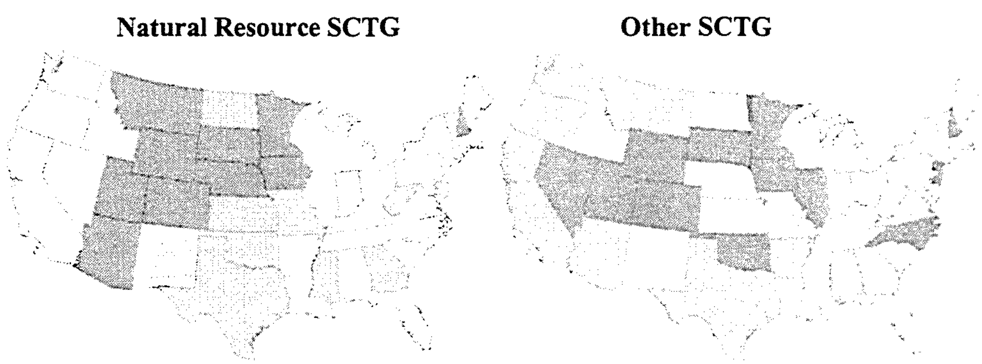

Figure 9. Rail Freight Quality for Natural Resource and Other Commodities, SCTG Commodity Classes
(Darker color for Higher Quality Indicator; Crosshatch for Not Available)

northern plains regions, with the exception of North Dakota, offer the highest quality rail freight. The area where the highest quality rail freight is available for other commodities includes some of the same states, neighboring states, and a smattering of states along the east coast. As the illustration suggests, benefits of a competitive rail transport system generally are enjoyed by all commodity classes as the natural-resource and higher-value freight rail rates are highly correlated ($p=0.627, \propto=.000$), but there are different market-based influences affecting the rail rate structures across states.

Water Indicator

Water is the final mode considered in the transportation quality index. Overall, about 5 percent of the freight movements reported in the CFS were transported via water. These water movements include inland barge and intercostal vessel movements. Energy, agriculture, and chemical industries are the primary users of water transport, with these industries shipping more than 15 percent of their product via water. The utilization of water by these industries is logical given that water is the low-cost alternative for longer-distance, bulk shipments. Product characteristics and proximity typically determine the economic viability of water transport.

Inherent qualities make water-based transport rather rigid in terms of geography and capacity. The economics of water transport, for products conducive to this mode, largely is determined by proximity to water. Because the scope of products considered in this research is unlimited, the average distance to water from mesocities in a state is offered as a proxy for water transport in the composite transportation service index. Distance to water averaged 169 miles, ranging from 6 miles to more than 600 among the mesocity locations. For industries with products suited for the typical large-volume, longer-distance shipments, economic benefits of water proximity are in the ability to access barge and intercoastal shipping alternatives and in the gains associated with water-compelled pricing practices employed to compete with the low-cost carrier.

Modal Indicator Relationships

Relationships among the composite indicator components show evidence of market-based competition. Correlations among the state-level truck, rail, and water indicator proxies are presented in Table 5. In addition, the natural-resource commodity and other commodities are presented as they are referenced in this and previous sections. Given inherent differences in the type of service offered by water and truck, the insignificant relationship between these modes is expected. The evidence of modal competition is offered in the inverse relationship between the truck and rail indicators ($p=-0.500$, $\propto.000$). As truck service (density) improves so does rail service (rates). The relationship between natural-resource rail rates and water distances is expected to show a positive significant relationship. The relationship, however is not shown to be statistically significant.

Table 5. Relationships Among Composite Freight Indicator Modal Components

		Water *(Distance)*	Truck *(Density)*	Rail, Commodity Groups *(Revenue-per-Ton Mile)* All	Natural-Resource	Other
Water	Corr.	1.000	.299	-.404**	-.175	-.456**
	Sig.	.	.052	.007	.286	.002
Truck	Corr.	.299	1.000	-.500**	-.395*	-.390**
	Sig.	.052	.	.000	.012	.007
Rail						
All	Corr.	-.404**	-.500**	1.000	.844**	.788**
	Sig.	.007	.000	.	.000	.000
Nat. Resource	Corr.	-.175	-.395*	.844**	1.000	.627**
	Sig.	.286	.012	.000	.	.000
Other	Corr.	-.456**	-.390**	.788**	.627**	1.000
	Sig.	.002	.007	.000	.000	.

** Correlation is significant at the 0.01 level (two-tailed).
* Correlation is significant at the 0.05 level (two-tailed).
N=39 to 47

The level of aggregation and simple correlation measures may dilute the effects of this relationship and explain the unexpected negative and significant relationship between the all-commodity rail and water indicators. The negative relationship between water proximity and the other commodity rail rates is statistically significant. This suggests that market factors allow for higher rail rates near water. Although not specifically addressed in this research, literature suggests that factors may include product characteristics, customer demands such as higher transit time requirements, and diseconomies associated with shorter rail movements. The relationships among the modal components in the composite freight indicator suggest that market-based competition is a factor in transport service. The discussion also implies there are unexpected indicator relationships that may be investigated in future research and should be considered as data sources are assessed.

Business Traveler Transport Quality Index

The second transport quality indicator developed for mesocity economic analysis is the measure of business travel quality. In the globalized market economy, the role of travel is increasingly important. Contrary to notions that technological advancements in communication, including speed, reliability, and flexibility, would substitute for travel, research suggests the relationship is complimentary. As the mesocity economies seek to develop and integrate into a global marketplace, business travel likely will remain an important factor in business investment decisions.

Air and automobile travel are the primary modes for business travel. Previous research estimates that substitution of automobile for plane is limited to distances under 300 miles. In pragmatic terms, this distance seems reasonable as the estimated nine hours of driving time would allow a traveler to make the round-trip in a single 10-hour work day. The business travel quality indicator is based on distance from a hub airport. It is assumed that air travel is required to attract and retain businesses. The hub airports offer primary gateways for domestic and international air travel. To augment the information presented in earlier studies on business travel, a regression model of airfares to hub airports from all airports was estimated to ascertain the role of factors such as city population, regional locale, jet service, and distance in airfares paid to access service from hub airports. The regression model will provide justification for the proxy selected and offer insight for customizing the quality index for individual cities. The model also will provide cities with data to maintain and pursue high quality business traveler transportation.

A multivariate regression model is used to assess the roles of geographic and social factors in airfares paid by travelers across the nation when they travel to hub airports. The average fare per mile is defined as the dependent variable in the estimation. The exogenous variables are flight distance from the origin city to the hub airport, origin city population, and dummy variables for competition and service. Other variables such as origin city geographic region location and airport category and destination city size were tested and dropped from the model and not found to have statistically significant relationships to the independent variable. Using the Department of Transportation *Domestic Airfares Consumer Report* sample of airfares from 2000 to 2002, and airport profiles from the *National Transportation Atlas Database, 2002* an ordinary least squares model of airfares is presented. The model, in its log form, is defined as:

$$\ln AFPM = \beta_0 + \beta_1 \ln DIS + \beta_2 \ln POP + \beta_3 AUTOSUB + \beta_4 JET$$

AFPM	=	Airfare per mile
DIS	=	Flight distance between origin city and hub airport
POP	=	Origin city population
AUTOSUB	=	Dummy variable for automobile travel, flight distance of 300 miles
JET	=	Jet service at origin airport

A log-linear model form for the airfares is selected as the fares are expected to increase at a decreasing rate at longer distances due to the higher terminal, or fixed cost, associated with air travel. The length of flight (DIS) measures the effect of economies of distance in air travel and is expected to have a negative sign. The population of the origin city, defined by the 2000 U.S. Census, is expected to be inversely related to the airfare per mile. Population is likely a measure of many factors it offers a proxy for identifying agglomeration economies. As population increases, travelers in the origin city are expected to be able to achieve some economies of scale in the resources they outlay for air travel services.

Two dummy variables are included to control for modal competition and service. The effects of substituting automobile (AUTOSUB) for air travel is included with a dummy variable differentiating flights equal to or greater than 300 miles and those flights less than 300 miles. The modal competition variable is expected to have a positive sign as flights greater than 300 miles are posited to be less susceptible to competitive pressure from highway travel. The final variable controls for the service with the indicator that an airport has jet service. Jet service is expected to have a positive sign with the improvement of service quality from prop to jet planes. Variables controlling for airport size and regional airport location were tested in initial models, but the variables were not included in the final model as their relationship to the airfare per mile variable were not found to be statistically significant.

The model estimate provides an acceptable view of airfare levels among U.S. airports to hub airports. The exogenous variables included in the model explains approximately 77 percent of the variation in the dependent airfare per mile variable. All variables are statistically significant at the 90th percentile or higher and exhibit the expected signs (Table 6). The predominant factor in the model is distance, as more than 80 percent of the explained variance is attributed to this factor.

Table 6. Estimation of Airfare per Mile from U.S. Airports to Hub Airports

Variable	Estimate	t-ratio
Intercept	3.71384	26.71*
DIS	-0.71422	-48.52*
POP	-0.03815	-4.81*
AUTOSUB	0.25130	6.02*
JET	0.04589	1.73**

Adjusted $R^2 = .77$ F=1,103 N=1,291
* significant at the 1% level; ** significant at the 10% level;
Note: All continuous variables are in natural logarithms.

The differentiation of traffic based on competition also is an important factor as approximately 10 percent of the fare is determined by the control variable that identifies flights under 300 miles. The model also supports the presence of agglomeration economics, as the relationship between origin city population and airfare per mile is statistically significant, and negative as expected. Although the effects of agglomeration economies is small, it is attributed with explaining about 5 percent of the overall variation in airfares. The effects of jet service on the airfare are small, explaining about 1 percent of airfare variance. The JET variable does, however, confirm a small premium in the market for airports equipped to handle the larger airplane associated with more amenities and improved air service.

The model results support the premise that distance is a key factor in the fare-setting practices of U.S. airlines. Based in the presumption that air travel is an important factor in attracting businesses for economic development, distance-to-hub airport is offered as a proxy for classifying business travel quality among non-metropolitan cities in terms of relative competitiveness. The average distance from mesocity to hub airport is 190 miles, with mileage skewed toward the lower distances resulting in a distance of median at 168 miles. The lower and upper quartiles are defined by distances below 110 miles and above 242 miles, respectively.

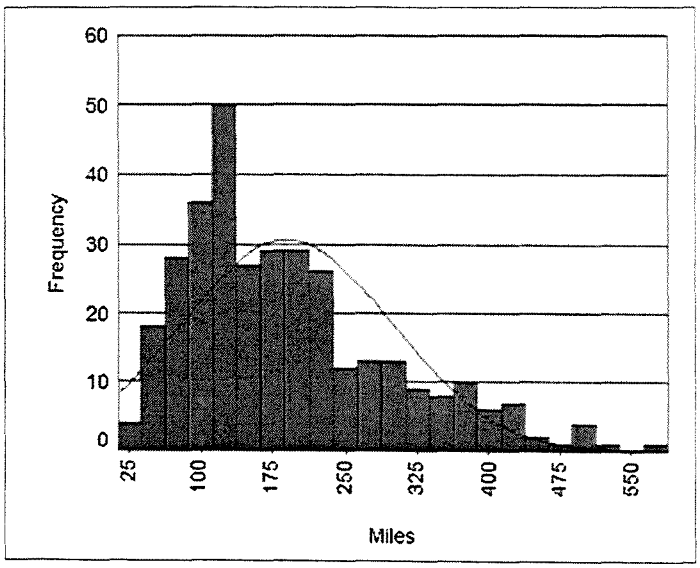

Figure 10. Distribution of Mesocity to Closest Hub Airport Distances

The distribution of mesocities' distances-to-hub airport have a highly positive skew as measured at 0.976, suggests a tail to the right in the distribution. The distribution also is slightly platokurtic, which indicates the distribution curve is flatter than a normal curve. The flatness suggests that deviations are larger than with a normal distribution. The skewness indicates a larger proportion of the mesocities are in closer proximity to a hub airport. These measures suggest that the mesocity population has somewhat heterogeneous distribution with regard to hub airport proximity.

The state-level illustration of the average mesocity travel indicator offers regional insight for assessing the role of business travel in economic development pursuits (Figure 11). Although individual mesocities in these states may have indicators higher or lower than the state average, state borders provide an important delineation for discussing policy and investment notions that may impact business travel. States in the northeast, along with Utah, Illinois, Indiana, and Ohio enjoy the highest quality business travel, considering mesocity proximity to hub airports. The state business traveler quality indicators show that states in the central plains and western Gulf regions as disadvantaged in terms of their ability to offer quality business travel.

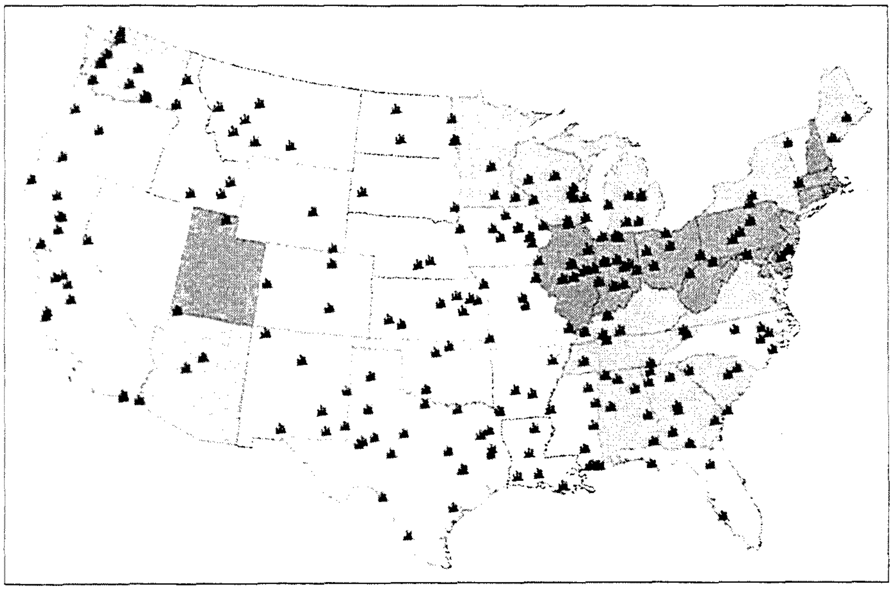

Figure 11. Business Travel Quality Indicator (Darker color for Higher Quality Indicator)

SUMMARY

This research offers insight into the relative quality of transport services available for economic development of non-metropolitan cities located across rural regions of the United States. These non-metropolitan cities selected as the focus for this research are termed "mesocities." Mesocities are U.S. cities with 25,000 to 250,000 residents located in counties not adjacent to metropolitan areas. Mesocities offer rural areas the opportunity to derive some of the agglomeration benefits typically associated with urbanization. The goal of this research is to estimate indicators of the relative service quality for freight and business travel among mesocities. The transport indicators provide valuable information about the competitive position of cities, and their surrounding region, as they pursue economic development strategies.

Findings suggest that transport services are largely a function of market competition for natural and man-made resources under the deregulated market scheme initiated with legislation passed more than two decades ago. Mesocities in the Midwest have the highest overall-quality freight services. A general weakness of overall freight-service quality indicators for mesocities in eastern states, along with Florida, Tennessee, and Texas is a concern because research suggests that there is a tendency for those lagging in transport quality to become more disadvantaged over time. Considering the quality of rail freight transport, non-metropolitan cities in the central and northern plains have an advantage in serving natural-resource-based industries. The business travel indicator does not follow the same pattern for service quality, suggesting that freight and business travel resources are not allocated in similar ways. Although business travel service still is strongest for mesocities located in eastern states, there is a distribution in the range of service qualities across states the central, southern, and western regions.

The freight and business transport indicator research offers non-metropolitan cities insight into the competitiveness of the transport services they offer for attracting and growing businesses. The natural and man-made transport resources established to satisfy the demands of agricultural and industrial economies should be given ongoing evaluation under the new information-market economy. This research establishes baseline transport-quality indicators. In addition, the mode-specific measures for freight quality offer insight that may be important because the overall indicator may be dominated by a predominant industry. This information may be useful in an ongoing assessment. The knowledge gleaned, as it is updated and customized information, may be a valuable resource in devising successful policy initiatives and economic development strategies that use the mesocity as a nexus to integrate regional rural economies into the national and global market. In addition to the new opportunity to integrate transportation quality into rural economic development discussions, this research may encourage future consideration of new and improved data sources to measure transportation service quality in non-metropolitan areas.

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APPENDIX A. LIST OF MESOCITIES, STATE AND CITY NAME, STATES A-M

State	City Name	State	City Name	State	City Name	State	City Name
AL	Auburn	DE	Dover	IL	Bloomington	KY	Bowling Green
AL	Decatur	FL	Gainesville	IL	Champaign	KY	Hopkinsville
AL	Dothan	FL	Panama City	IL	Danville	KY	Owensboro
AL	Florence	FL	Port Charlotte	IL	Decatur	KY	Paducah
AL	Gadsden	GA	Albany	IL	Kankakee	LA	Alexandria
AL	Tuscaloosa	GA	Dalton	IL	Normal	LA	Houma
AR	Hot Springs	GA	Gainesville	IL	Quincy	LA	Lafayette
AR	Jonesboro	GA	Hinesville	IL	Springfield	LA	Lake Charles
AR	Pine Bluff	GA	Macon	IL	Urbana	LA	Monroe
AR	Texarkana	GA	Rome	IN	Anderson	MA	Pittsfield
AZ	Flagstaff	GA	Valdosta	IN	Bloomington	MD	Hagerstown
AZ	Prescott	GA	Warner Robins	IN	Columbus	ME	Bangor
AZ	Yuma	IA	Ames	IN	Elkhart	ME	Lewiston
CA	Atascadero	IA	Burlington	IN	Goshen	MI	Battle Creek
CA	Calexico	IA	Cedar Falls	IN	Kokomo	MI	Bay City
CA	Chico	IA	Cedar Rapids	IN	Lafayette	MI	Jackson
CA	El Centro	IA	Dubuque	IN	Michigan City	MI	Mount Pleasant
CA	Eureka	IA	Fort Dodge	IN	Muncie	MI	Muskegon
CA	Hanford	IA	Iowa City	IN	Richmond	MI	Saginaw
CA	Los Banos	IA	Marion	IN	Terre Haute	MN	Mankato
CA	Madera	IA	Mason City	IN	West Lafayette	MN	Moorhead
CA	Merced	IA	Sioux City	KS	Dodge City	MN	Rochester
CA	Napa	IA	Waterloo	KS	Emporia	MN	St. Cloud
CA	Paradise	ID	Coeur d'Alene	KS	Garden City	MO	Cape Girardeau
CA	Redding	ID	Idaho Falls	KS	Lawrence	MO	Columbia
CA	San Luis Obispo	ID	Lewiston	KS	Manhattan	MO	Jefferson City
CA	Yuba City	ID	Pocatello	KS	Salina	MO	Joplin
CO	Grand Junction	ID	Twin Falls	KS	Topeka	MO	St. Joseph
CO	Greeley						

APPENDIX B. LIST OF MESOCITIES, STATE AND CITY NAME, STATES N-W

State	City Name	State	City Name	State	City Name	State	City Name
MS	Biloxi	NM	Carlsbad	SD	Rapid City	UT	Logan
MS	Columbus	NM	Clovis	SD	Sioux Falls	UT	St. George
MS	Greenville	NM	Farmington	TN	Clarksville	VT	Burlington
MS	Gulfport	NM	Hobbs	TN	Cleveland	WA	Bellingham
MS	Hattiesburg	NM	Las Cruces	TN	Jackson	WA	Bremerton
MS	Meridian	NM	Roswell	TN	Johnson City	WA	Kennewick
MS	Pascagoula	NM	Santa Fe	TN	Kingsport	WA	Lacey
MS	Tupelo	NV	Carson City	TX	Abilene	WA	Longview
MT	Billings	NY	Elmira	TX	Amarillo	WA	Mount Vernon
MT	Bozeman	NY	Ithaca	TX	Big Spring	WA	Olympia
MT	Butte-Silver Bow	OH	Lima	TX	Bryan	WA	Pasco
MT	Great Falls	OH	Mansfield	TX	College Station	WA	Richland
MT	Helena	OH	Sandusky	TX	Del Rio	WA	Wenatchee
MT	Missoula	OH	Springfield	TX	Laredo	WA	Yakima
NC	Burlington	OK	Enid	TX	Longview	WI	Appleton
NC	Goldsboro	OK	Lawton	TX	Lubbock	WI	Beloit
NC	Greenville	OK	Ponca City	TX	Lufkin	WI	Eau Claire
NC	Jacksonville	OR	Bend	TX	Midland	WI	Fond du Lac
NC	Rocky Mount	OR	Corvallis	TX	Nacogdoches	WI	Janesville
ND	Bismarck	OR	Medford	TX	Odessa	WI	La Crosse
ND	Fargo	PA	Altoona	TX	San Angelo	WI	Oshkosh
ND	Grand Forks	PA	State College	TX	Sherman	WI	Racine
ND	Minot	PA	Williamsport	TX	Texarkana	WI	Sheboygan
NE	Grand Island	SC	Anderson	TX	Tyler	WI	Wausau
NE	Kearney	SC	Florence	TX	Victoria	WV	Morgantown
NJ	Millville	SC	Hilton Head Island	TX	Waco	WV	Parkersburg
NJ	Vineland	SC	Sumter	TX	Wichita Falls	WV	Wheeling
						WY	Casper
						WY	Cheyenne

APPENDIX C. MODAL WEIGHTS FOR COMPOSITE FREIGHT INDEX CALCULATION

	Rail	Truck	Water
	Modal Share		
All States	16%	78%	6%
Alabama	13%	85%	2%
Arizona	26%	74%	0%
Arkansas	12%	88%	0%
California	3%	95%	2%
Colorado	22%	78%	0%
Connecticut	0%	100%	0%
Delaware	8%	92%	0%
Florida	25%	75%	0%
Georgia	11%	89%	0%
Idaho	33%	67%	0%
Illinois	22%	70%	7%
Indiana	16%	79%	5%
Iowa	17%	83%	0%
Kansas	22%	78%	0%
Kentucky	34%	51%	15%
Louisiana	13%	54%	33%
Maine	7%	93%	0%
Maryland	6%	94%	0%
Massachusetts	1%	99%	0%
Michigan	10%	83%	7%
Minnesota	25%	75%	0%
Mississippi	9%	78%	13%
Missouri	6%	83%	11%
Montana	60%	40%	0%
Nebraska	32%	68%	0%
Nevada	5%	95%	0%
New Hampshire	0%	100%	0%
New Jersey	2%	84%	14%
New Mexico	34%	66%	0%
New York	3%	97%	0%
North Carolina	7%	93%	0%
North Dakota	55%	45%	0%
Ohio	9%	88%	3%
Oklahoma	15%	83%	2%
Oregon	6%	91%	3%
Pennsylvania	18%	77%	5%
Rhode Island	0%	100%	0%

South Carolina	8%	92%	0%
South Dakota	15%	85%	0%
Tennessee	7%	91%	2%
Texas	20%	70%	10%
Utah	52%	48%	0%
Vermont	0%	100%	0%
Virginia	20%	80%	0%
Washington	7%	84%	9%
West Virginia	51%	34%	15%
Wisconsin	7%	93%	0%
Wyoming	92%	8%	0%

Source: Bureau of Transportation Statistics, 1997.

APPENDIX D. FREIGHT INDEX CALCULATED VALUES, BY STATE

	Rail Index Value *Avg. RPTM, Rail Freight 1999-2000*	Truck Index Value *Ratio for-hire trucks/ 2000 population*	Water Index Value *Avg. Miles to Water Terminal*	Business Travel Index Value *Avg. Miles to Air Hub*
All States	4.42	16.4	169	195
Alabama	4.44	11.3	26	157
Arizona	5.71	17.4	409	154
Arkansas	5.20	14.1	65	272
California	4.84	15.8	159	179
Colorado	2.37	11.2	629	181
Connecticut	5.90	20.3	n.a.	n.a.
Delaware	5.53	17.8	70	64
Florida	6.18	21.9	61	219
Georgia	5.22	14.4	98	137
Idaho	4.37	9.2	302	254
Illinois	5.23	18.4	59	100
Indiana	5.16	14.9	88	107
Iowa	2.92	10.3	85	199
Kansas	3.72	9.0	180	338
Kentucky	3.77	11.9	21	178
Louisiana	5.52	16.0	51	250
Maine	n.a.	14.8	45	167
Maryland	7.14	19.1	74	92
Massachusetts	7.48	20.1	124	99
Michigan	12.54	18.7	52	117
Minnesota	2.90	11.9	102	116
Mississippi	5.04	16.7	41	355
Missouri	5.51	13.7	44	186
Montana	2.75	7.8	365	493
Nebraska	2.76	7.9	162	399
Nevada	3.77	16.2	140	240
New Hampshire	4.13	13.2	n.a.	n.a.
New Jersey	5.81	25.9	37	50
New Mexico	5.56	13.6	643	418
New York	6.35	32.5	140	169
North Carolina	5.38	16.6	161	190
North Dakota	3.67	5.2	349	364
Ohio	6.16	17.4	72	99
Oklahoma	3.92	8.1	148	228
Oregon	4.96	11.0	169	217
Pennsylvania	4.60	22.3	130	115
Rhode Island	5.49	25.5	n.a.	n.a.
South Carolina	5.87	12.9	114	155
South Dakota	2.80	5.6	366	324
Tennessee	4.56	18.9	79	176
Texas	4.93	19.1	254	203

Utah	2.80	17.5	502	108
Vermont	5.03	12.0	145	215
Virginia	5.86	15.2	51	152
Washington	4.36	15.3	39	117
West Virginia	3.91	18.7	6	78
Wisconsin	5.35	14.4	65	132
Wyoming	1.56	6.6	566	207

n.a., data not available